# Upcoming Revisions
# to
# Field Triage Criteria

Stewart C. Wang, MD PhD
Professor and Associate Chairman of Surgery
Director, UMPIRE
University of Michigan

**CIREN Public Meeting, Milwaukee WI**
**September 2006**

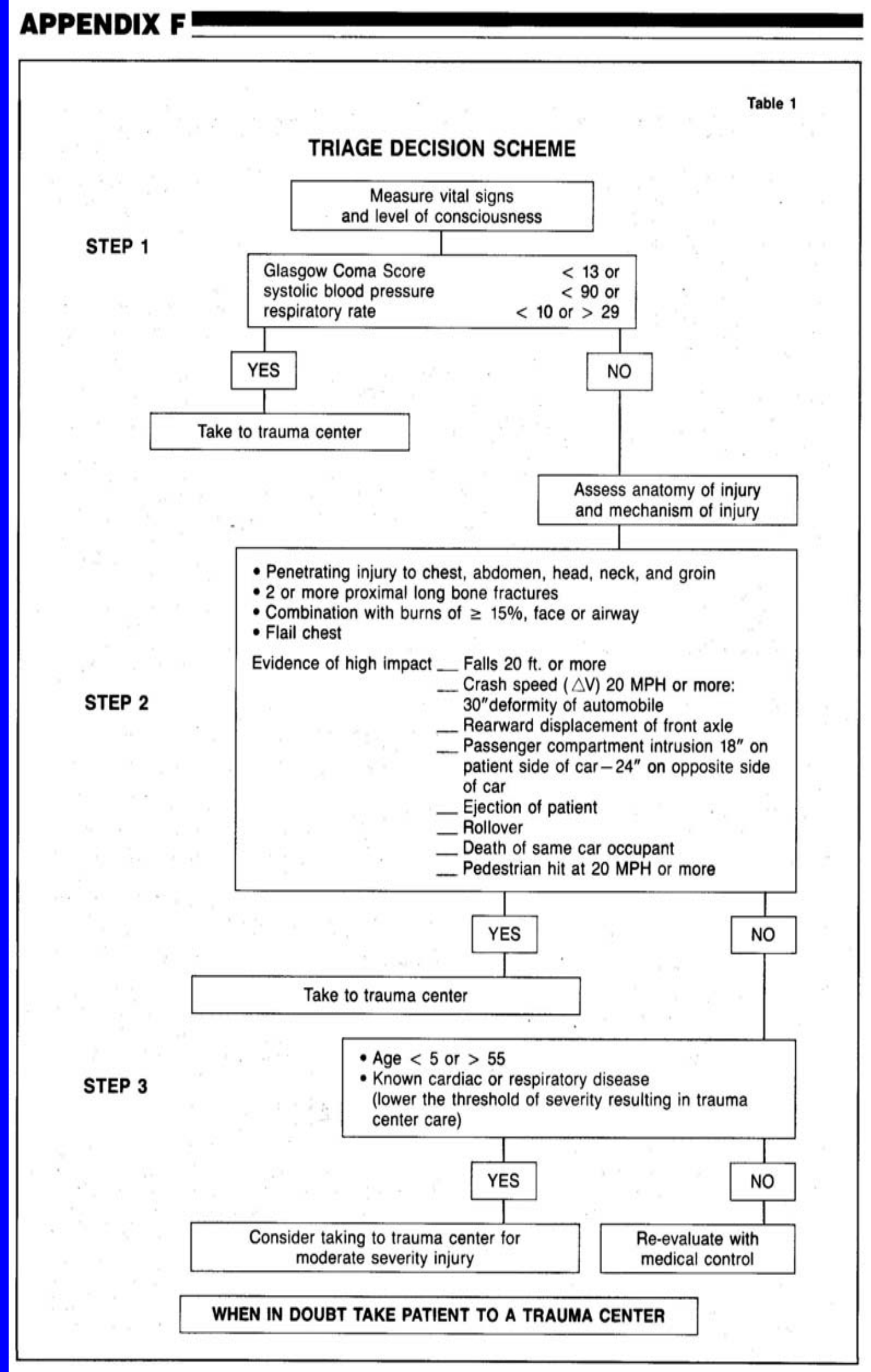
# 1987 Freestanding document:

## "Hospital and Prehospital Resources for Optimal Care of the Injured Patient"

- Initial algorithm for pre-hospital trauma triage
- Reproduced in PHTLS documents
- Used 3 triage domains:
  - physiologic
  - anatomic
  - mechanistic
  - special populations

- Revised 1990 Orange Book
- Revised 1993 Blue Book

***<u>Adopted around the world</u>***



# 1999 “Gold Book”

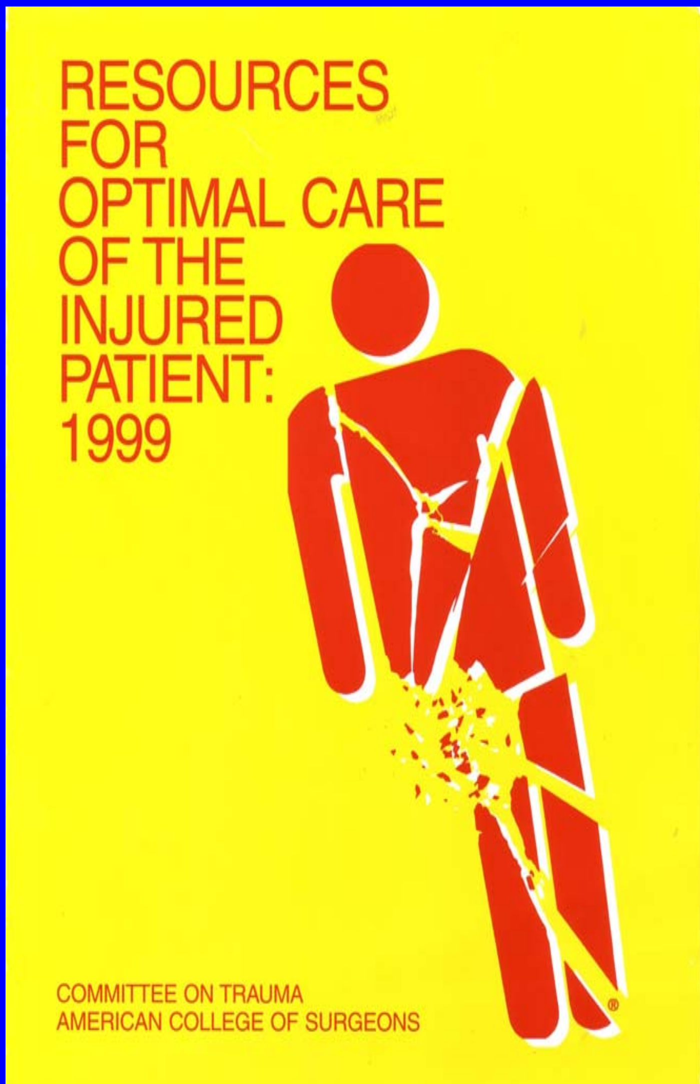



TABLE 1
FIELD TRIAGE DECISION SCHEME

Measure vital signs and level of consciousness

ep One[1]

Glasgow Coma Scale .................. <14 or[2]
Systolic blood pressure ................ <90 or
Respiratory rate ...................... <10 or >29
Revised Trauma Score (see Table 2) ...... <11

YES — Take to trauma center; alert trauma team.
Steps 1 and 2 triage attempts identify the most seriously injured patients in the field. In a trauma system, these patients would preferentially be transported to the highest level of care within the system.

NO — Assess anatomy of injury

ep Two[3]

- All penetrating injuries to head, neck, torso, and extremities proximal to elbow and knee
- Flail chest
- Combination trauma with burns
- Two or more proximal long-bone fractures
- Pelvic fractures
- Open and depressed skull fracture
- Paralysis
- Amputation proximal to wrist and ankle
- Major burns (see Chapter 14: Guidelines for the Operation of Burn Units)

YES — Take to trauma center; alert trauma team
Steps 1 and 2 triage attempts identify the most seriously injured patients in the field. In a trauma system, these patients would preferentially be transported to the highest level of care within the system.

NO — Evaluate for evidence of mechanism of injury and high-energy impact

tep Three[4]

- Ejection from automobile
- Death in same passenger compartment
- Extrication time >20 minutes
- Falls >20 feet
- Rollover
- High-speed auto crash: Initial speed >40 mph; Major auto deformity >20 inches; Intrusion into passenger compartment >12 inches
- Auto-pedestrian/auto-bicycle injury with significant (>5 mph) impact
- Pedestrian thrown or run over
- Motorcycle crash >20 mph or with separation of rider from bike

YES — Contact medical direction and consider transport to a trauma center
Consider trauma team alert

NO

tep Four[5]

- Age <5 or >55
- Cardiac disease, respiratory disease
- Insulin-dependent diabetes, cirrhosis, or morbid obesity
- Pregnancy
- Immunosuppressed patients
- Patient with bleeding disorder or patient on anticoagulants

YES — Contact medical direction and consider transport to trauma center
Consider trauma team alert

NO — Reevaluate with medical direction

WHEN IN DOUBT TAKE TO A TRAUMA CENTER

Step One

Step Two

# TABLE 1
# FIELD TRIAGE DECISION SCHEME

Measure vital signs and level of consciousness

| | |
|---|---|
| Glasgow Coma Scale | <14 or[2] |
| Systolic blood pressure | <90 or |
| Respiratory rate | <10 or >29 |
| Revised Trauma Score (see Table 2) | <11 |

YES

Take to trauma center; alert trauma team.
Steps 1 and 2 triage attempts identify the most seriously injured patients in the field. In a trauma system, these patients would preferentially be transported to the highest level of care within the system.

NO

Assess anatomy of injury

- All penetrating injuries to head, neck, torso, and extremities proximal to elbow and knee
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Evaluate for evidence of mechanism of injury and high-energy impact

Step Three

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Contact medical direction and consider transport to a trauma center
Consider trauma team alert

NO

Step Four

- Age <5 or >55
- Cardiac disease, respiratory disease
- Insulin-dependent diabetes, cirrhosis, or morbid obesity
- Pregnancy
- Immunosuppressed patients
- Patient with bleeding disorder or patient on anticoagulants

YES

Contact medical direction and consider transport to trauma center
Consider trauma team alert

NO

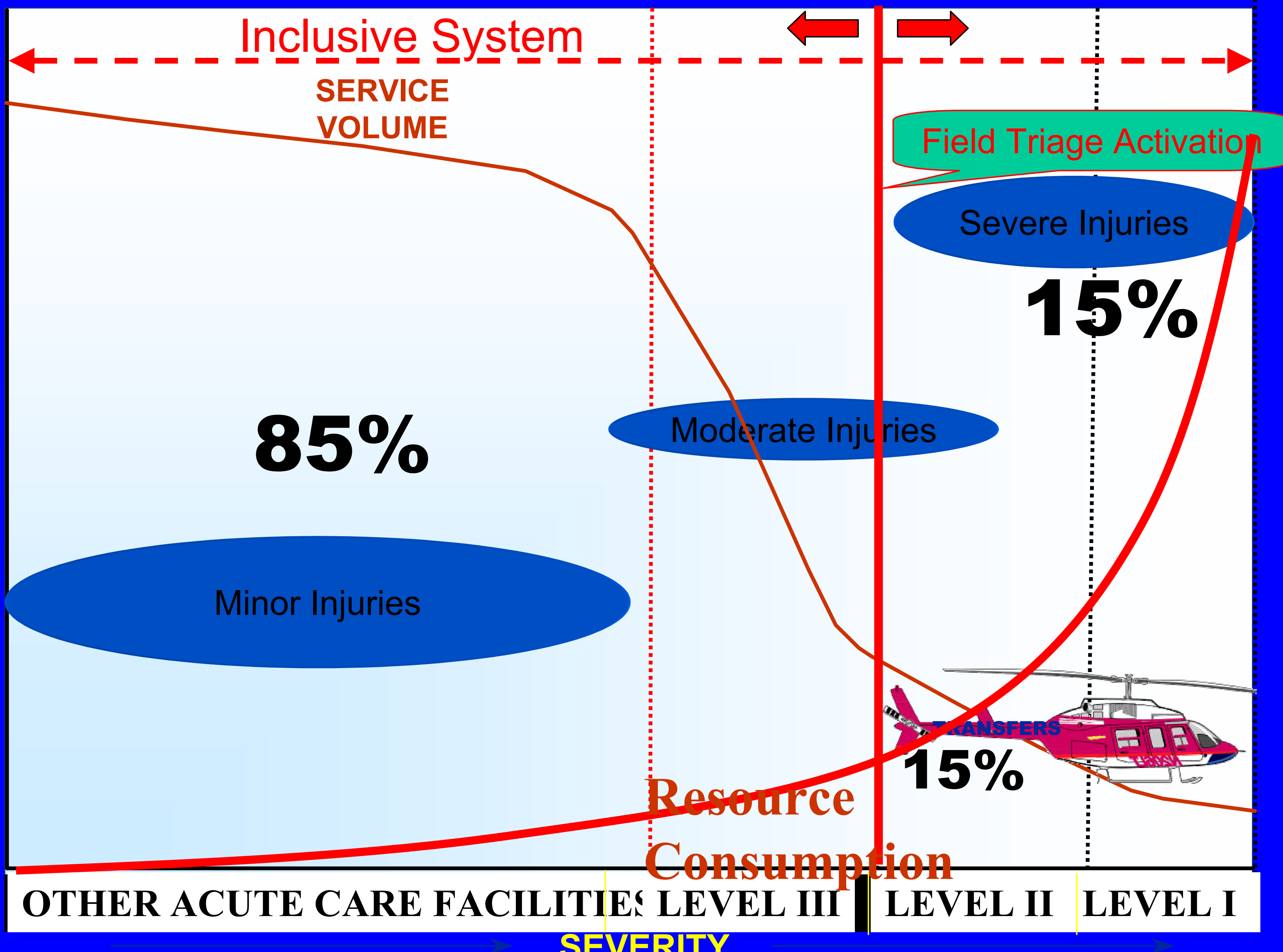
Reevaluate with medical direction

**WHEN IN DOUBT TAKE TO A TRAUMA CENTER**

# Why is this guideline important?

- Adopted as operating policy by
  - EMS and health care systems
  - Local, regional, state and national governments worldwide
  - Insurance and other payors
- Directly impacts how crash occupants are treated
- Greatly affects the clinical load (business) at trauma and non-trauma centers

# A MODEL TRAUMA SYSTEM



# Trends towards non-inclusive systems

- Centralizing <u>all</u> trauma care
  - may worsen adverse selection
  - results in poor utilization of resources
  - may overwhelm existing centers
  - may delay treatment of major injuries
  - may lessen the ‘system’ capability to respond to MCI / disaster

# Things change….

- Trauma systems have evolved
- Expansion of air medical coverage
- EMS training has expanded
- Existing field triage criteria have been field-tested
- Trauma patterns and mechanisms have shifted
- Technology has evolved (telemedicine, vehicles, etc)
- Laws and policies have changes (EMTALA, HIPPAA) as have health care economics.

# Context

- Trauma and EMS systems were less developed when the ACS-COT field triage criteria were last revised.
- There are increasing demands on EMS and medical centers to improve coordination and optimally utilize available resources.
- Need to balance needs of highly populated urban centers possessing advanced trauma systems with those of rural communities with limited capabilities and resources.
- Changes to the field triage criteria affects policy and many parties (therefore many local, state and federal agencies).

# Process

- Gather representatives from involved governmental agencies, professional societies, practitioners and experts.

- Put them in a room and examine all their perspectives, issues and needs.

- May 2005 – full panel
- November 2006 – small working group
- April 2006 – Finalization of revisions

# Field Triage Revision Panel

- CDC
  - **Richard C. Hunt, MD, FACEP**
    - Director, Division of Injury and Disability Outcomes and Programs (DIDOP)
  - **Ileana Arias, Ph.D.**
    - Acting Director , National Center for Injury Prevention and Control (NCIPC)
  - **John Seggerson, Bob Bailey …..**

- Health Resources and Services Administration (HRSA)
  - **CDR Cheryl Anderson**
    - Director, Trauma-EMS Program

- National Highway Traffic Safety Administration (NHTSA)
  - **Drew E. Dawson,**
    - Chief , EMS Division

# Field Triage Revision Panel

- **William Ball**
  - Vice President, Public Policy
  - OnStar
- **Robert R. Bass, MD, FACEP**
  - President NASEMSD
  - Executive Director, Maryland Institute for EMS Systems
- **Robert L. Galli, MD**
  - Chair of Emergency Medicine, Univ Mississippi
  - Executive Director of TelEmergency
- **Jerris R. Hedges, MD, MS**
  - Chair, Emergency Medicine
  - Orgeon Health & Science University
- **Mark C. Henry, MD**
  - Chair of Emergency Medicine, Stony Brook University
  - Former NY State Director of EMS
- **Troy Hogue**
  - Area Manager, Rual Metro
- **Robert O'Connor, MD, MPH, FACEP**
  - President NAMESP
  - Professor of Emergency Medicine, Thomas Jefferson Univ.
- **E. Brooke Lerner, PhD**
  - Assistant Professor of Emergency Medicine
- **Drexdal Pratt**
  - Chief, North Carolina Office of Emergency Medical Services
- **Gail Cooper**
  - Public Health Administrator (Retired)
  - Trauma Systems Consultation Committee
- **Mark Johnson**
  - Former state coordinator of EMS, Alaska
- **Gregory J. Jurkovich, MD, FACS**
  - Professor of Surgery, Harborview Medical Center
  - ACS-Committee on Trauma, Vice Chair
- **Jorie Klein, RN**
  - Trauma Coordinator, Parkland Hospital
- **Robert C. MacKersie, MD, FACS**
  - Professor of Surgery, UCSF
  - ACS-COT
- **Jane Ball, RN, DrPH**
  - Director, Emergency Medical Services for Children
  - National Resource Center
  - Children's National Medical Center
- **Daniel G. Hankins, MD**
  - Mayo Medical Transport, Emergency Medicine
- **Alasdair Conn, MD**
  - Massachusetts General Hospital Emergency Services
- **Jeffrey P. Salomone, MD FACS**
  - Trauma/Critical Care, Emory University, Grady Memorial
- **Roslyne D.W. Schulman**
  - Senior Associate Director for Policy Development
  - American Hospital Association
- **Rick Murray**
  - Manager, mergency Medical Services
  - American College of Emergency Physicians (ACEP)
- **Stanley J. Kurek, DO, FACS**
  - MUSC Dept. of Surgery
- **Jon Krohmer, MD**
  - Kent County EMS, Grand Rapids, MI
- **Paul Taheri, MD**
  - University of Michigan Trauma Center
- **Stewart C. Wang, MD, PhD, FACS**
  - Director, Program for Injury Research and Education
  - University of Michigan Health Systems

# Evaluation of the ACS Criteria

- Norcross 1995 –patients transported by ground EMS directly to the trauma center
- EMS completed survey on ACS criteria
- Severe trauma defined as ISS>15

| N=753 | Sensitivity | PPV |
|---|---|---|
| Physiologic Criteria | 65% | 42% |
| Anatomic Criteria | 45% | 22% |
| Physiologic and Anatomic | 83% | 27% |
| Mechanism of injury | 54% | 16% |
| Physiologic, Anatomic, and Mechanism of injury | 95% | 18% |

# Positive Predictive Value (PPV)

- is the proportion of people with a positive test who have the condition.

Consensus target:  20% PPV for ISS 15

# Evaluation of ACS criteria

- Wuerz 1996 – all helicopter transports from scene to trauma center over 2 years
  - Gold standard ISS>15
  - Note: providers used ACS for triage

| N=333 | ACS scheme | Physiologic | Situational (anatomic and mx) | Age/co-morbidity |
|---|---|---|---|---|
| Sensitivity | 97% | 56% | 87% | 56% |
| Specificity | 8% | 86% | 20% | 45% |
| PPV | 47% | 76% | 32% | 23% |
| NPV | 22% | 30% | 23% | 10% |

# Evaluation of ACS criteria

- Esposito 1995 – All patients who meet at least one of the criteria (identified prehospital or hospital) over a year statewide (n=2,260)
- 24% of patients who meet any one of the criteria had severe trauma
  - Resulting in 76% of patients being over triaged

| Criteria | ISS>15 |
|---|---|
| Prolonged prehospital time | 39% |
| Ped struck >20mph** | 35% |
| Physiologic | 32% |
| Occupant death | 23% |
| Anatomic | 23% |
| Vehicle intrusion | 23% |
| Deformity | 25% |
| Ejection | 24% |
| Provider gut feeling | 15% |
| Fall >20ft | 13% |
| Rollover | 12% |
| Comorbid Factors | 11% |

# Incremental Benefit of Individual American College of Surgeons Trauma Triage Criteria

*Mark C. Henry, MD, Judd E. Hollander, MD, Jeanne M. Alicandro, MD,*
*Guy Cassara, RN, RPA, AEMT, Susan O'Malley, BS, AEMT, Henry C. Thode Jr., PhD*

## ABSTRACT

**Objective:** To determine the incremental benefit of individual American College of Surgeons (ACS) trauma triage criteria for prediction of severe injuries after consideration of concurrent physiologic, anatomic, mechanism, or "other" criteria.

**Methods:** A prospective cross-sectional study of motor vehicle crash victims transported to any of the 12 hospitals in a suburban/rural county by local ambulance services was performed. Demographic and individual ACS criteria were collected using structured data instruments. EDs provided patient disposition within 24 hours of patient arrival. Medical records were reviewed. Major outcomes were admission, operative interventions (OR), major nonorthopedic operative interventions or death (Maj-OR), and injury severity score (ISS). To optimize sensitivity and specificity of out-of-hospital triage decision rules, receiver operating characteristic (ROC) curves were derived.

**Results:** Of 1,545 patients, 13% were admitted; 6% had OR; 1% had Maj-OR; and 3% had ISSs ≥16. For all outcomes, the most useful criteria were physiologic and anatomic. Some additional criteria (crash speed >20 mph, ≥30-inch vehicle deformity, axle displacement) substantially worsened specificity, with minimal or no improvement in sensitivity. For example, the optimal ROC curve for Maj-OR was determined by a systolic blood pressure <90 mm Hg, Glasgow Coma Scale (GCS) score <13, respiratory rate (RR) <10 or >29, death of a same-car occupant, penetrating injury, and/or ≥24-inch opposite-side compartment intrusion (sensitivity, 85%; specificity, 87%). An ISS ≥16 was predicted by GCS score <13, RR <10 or >29, penetrating injury, 2 proximal long bone fractures, flail chest, ≥24-inch opposite-side compartment intrusion, patient ejection, rollover, and/or age <5 or >55 years (sensitivity, 86%; specificity, 70%).

**Conclusion:** Physiologic and anatomic trauma triage criteria predicted increased hospital resource utilization and severe injury. On the other hand, when used concurrently with physiologic, anatomic, and "other" criteria, some mechanism criteria worsen specificity with negligible improvement in sensitivity. In particular, crash speed >20 mph and ≥30-inch vehicle deformity had little predictive value for all outcomes.

**Key words:** emergency medical services; trauma triage; outcome studies; resource use; trauma system; motor vehicle crashes.

*Acad. Emerg. Med.* 1996; 3:992–1000.

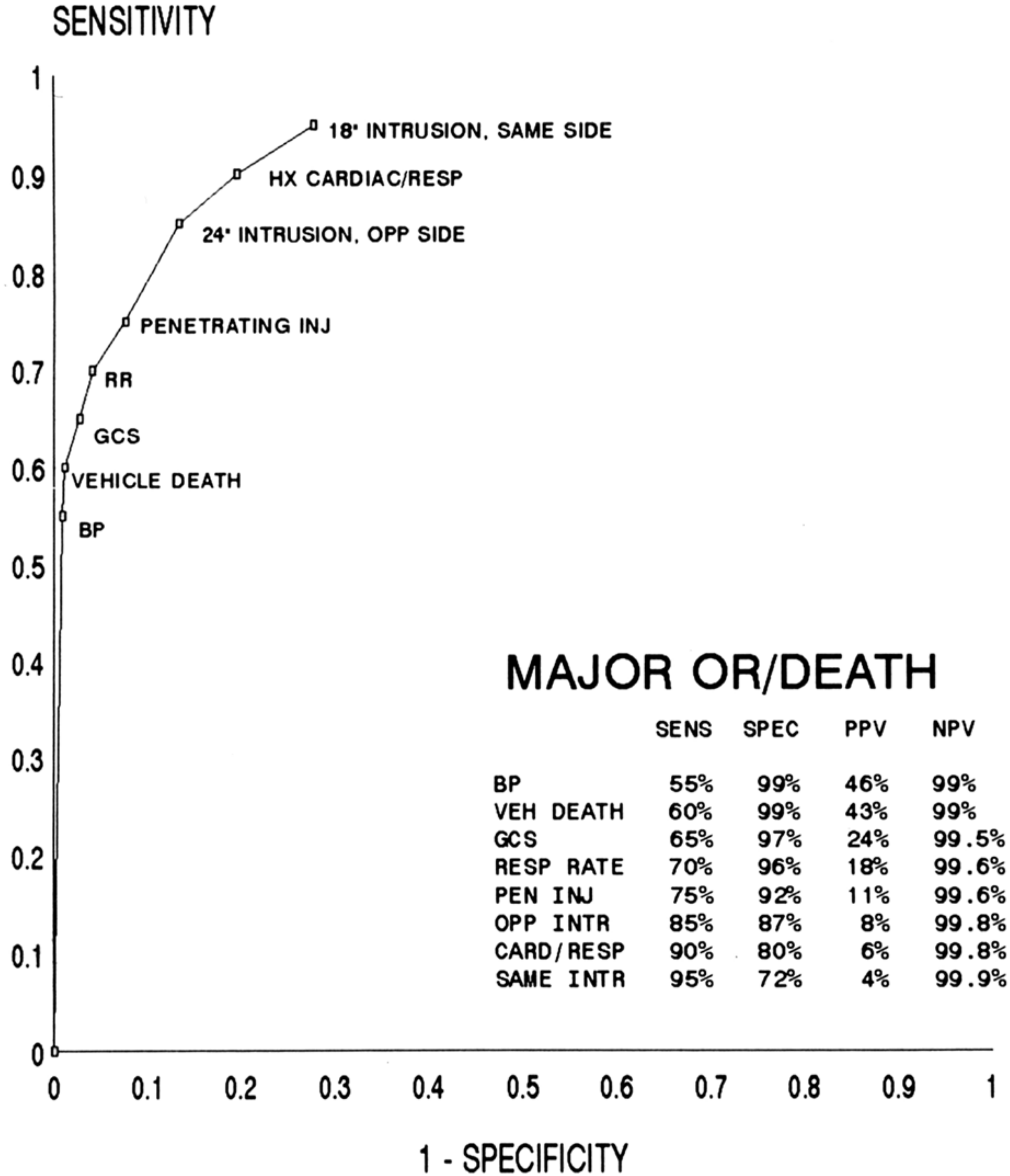
# Major Non-orthopedic OR or Death

Unadjusted and Adjusted Odds Ratios for Major Nonorthopedic Operative Interventions (or Death) for the American College of Surgeons Trauma Triage Criteria

| | Univariate Odds Ratio (95% CI) | Multivariate Odds Ratio (95% CI) |
|---|---|---|
| Physiologic criteria | | |
| Systolic blood pressure <90 mm Hg (*n* = 24) | 142.2 (50.4–400.7)* | 14.0 (2.3–84.0)* |
| Glasgow Coma Scale (GCS) score <13 (*n* = 45) | 67.8 (26.0–176.9)* | 5.0 (0.9–29.7) |
| Respiratory rate <10 or >29 breaths/min (*n* = 36) | 35.6 (13.5–94.0)* | 5.0 (0.8–29.9) |
| Anatomic criteria | | |
| Flail chest (*n* = 7) | 33.8 (6.1–185.7)* | 1.8 (0.1–31.4) |
| ≥2 proximal long bone fractures (*n* = 17) | 19.0 (5.0–72.4)* | 2.2 (0.1–40.6) |
| Penetrating injury (nonextremity) (*n* = 68) | 10.1 (3.8–27.2)* | 3.1 (0.5–17.7) |
| "Other" criteria | | |
| Age <5 or >55 years (*n* = 227) | 2.5 (1.0–6.6) | 2.2 (0.5–9.6) |
| Known cardiac or respiratory disease (*n* = 115) | 2.2 (0.6–7.7) | 2.6 (0.4–15.4) |
| Mechanism criteria | | |
| Crash speed >20 mph (*n* = 1,017) | 10.0 (1.3–75.2)* | 2.0 (0.2–18.6) |
| ≥30-inch vehicle deformity (*n* = 588) | 6.7 (2.2–20.0)* | 3.1 (0.7–14.1) |
| Rearward displacement of front axle (*n* = 207) | 3.6 (1.4–9.0)* | 1.3 (0.3–6.4) |
| Death of a same-vehicle occupant (*n* = 7) | 67.1 (13.9–323.0)* | 39.0 (2.7–569.6)* |
| Ejection of patient from the vehicle (*n* = 28) | — | — |
| Opposite-side intrusion >24 inches (*n* = 113) | 4.4 (1.6–12.3)* | 0.8 (0.1–4.8) |
| Same-side vehicle intrusion >18 inches (*n* = 208) | 6.7 (2.8–16.3)* | 1.0 (0.2–4.7) |
| Vehicle rollover (*n* = 89) | 1.8 (0.4–8.0) | 1.6 (0.1–18.9) |

*Significant predictor of injury severity score.

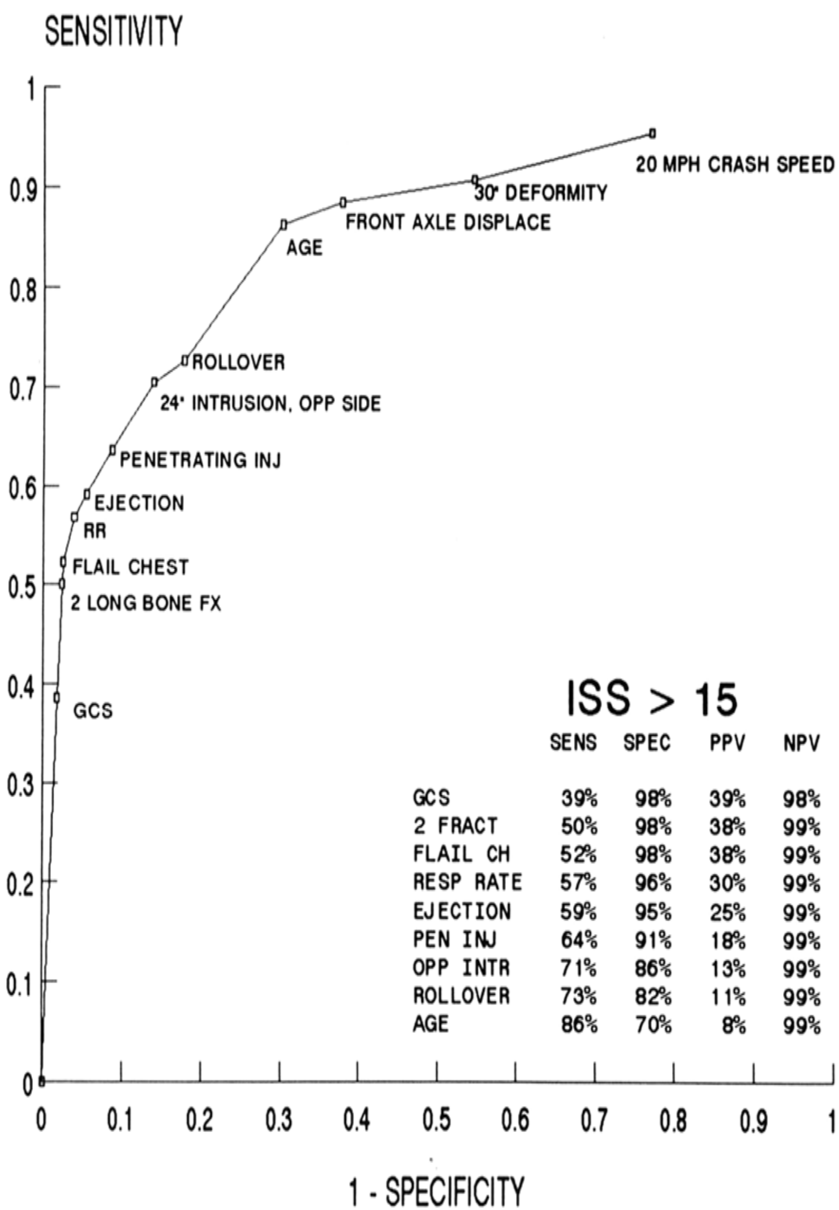
Henry 1996



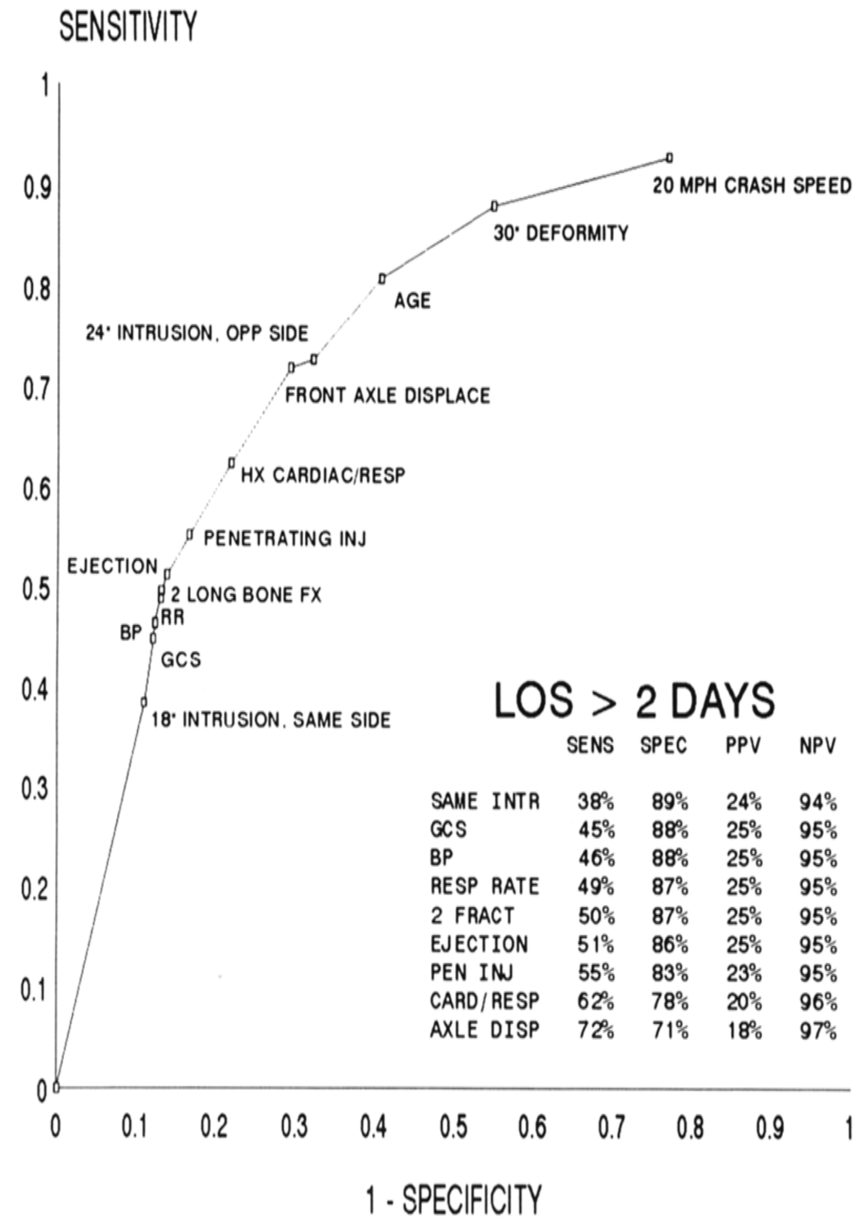

## MAJOR OR/DEATH

| | SENS | SPEC | PPV | NPV |
|---|---|---|---|---|
| BP | 55% | 99% | 46% | 99% |
| VEH DEATH | 60% | 99% | 43% | 99% |
| GCS | 65% | 97% | 24% | 99.5% |
| RESP RATE | 70% | 96% | 18% | 99.6% |
| PEN INJ | 75% | 92% | 11% | 99.6% |
| OPP INTR | 85% | 87% | 8% | 99.8% |
| CARD/RESP | 90% | 80% | 6% | 99.8% |
| SAME INTR | 95% | 72% | 4% | 99.9% |

Henry 1996




| | SENS | SPEC | PPV | NPV |
|---|---|---|---|---|
| GCS | 39% | 98% | 39% | 98% |
| 2 FRACT | 50% | 98% | 38% | 99% |
| FLAIL CH | 52% | 98% | 38% | 99% |
| RESP RATE | 57% | 96% | 30% | 99% |
| EJECTION | 59% | 95% | 25% | 99% |
| PEN INJ | 64% | 91% | 18% | 99% |
| OPP INTR | 71% | 86% | 13% | 99% |
| ROLLOVER | 73% | 82% | 11% | 99% |
| AGE | 86% | 70% | 8% | 99% |




| | SENS | SPEC | PPV | NPV |
|---|---|---|---|---|
| SAME INTR | 38% | 89% | 24% | 94% |
| GCS | 45% | 88% | 25% | 95% |
| BP | 46% | 88% | 25% | 95% |
| RESP RATE | 49% | 87% | 25% | 95% |
| 2 FRACT | 50% | 87% | 25% | 95% |
| EJECTION | 51% | 86% | 25% | 95% |
| PEN INJ | 55% | 83% | 23% | 95% |
| CARD/RESP | 62% | 78% | 20% | 96% |
| AXLE DISP | 72% | 71% | 18% | 97% |

**Henry 1996**

# Mechanism of Injury Criteria

- Knopp, R 1988
  - Prospective 9 week study of all EMS calls in a single county and transfers from surrounding counties.
  - Trauma defined ISS>15

| N=1,473 | N | PPV | Cumulative PPV |
|---|---|---|---|
| Spinal Injury | 4 | 100% | 100% |
| Amputation | 2 | 100% | 100% |
| Penetrating Injury | 48 | 60% | 65% |
| Burn | 8 | 38% | 61% |
| Extrication | 10 | 40% | 58% |
| Ejection | 67 | 22% | 40% |
| Fatality | 14 | 21% | 38% |
| Proximal long bone fx | 41 | 20% | 34% |
| Space intrusion | 84 | 19% | 29% |
| Auto vs ped | 56 | 18% | 27% |
| Fall > 15 ft | 7 | 14% | 27% |
| Age <1 or >65 | 144 | 12% | 20% |

# First meeting

A. Good field evidence, keep as criteria.
B. Acceptable criteria, needs more research/evidence.
C. Poor/confusing criteria. Delete as criteria.

| Mechanism | A | B | C |
|---|---|---|---|
| Ejection from auto | 11 | 1 | 0 |
| Death in same passenger compartment | 3 | 6 | 1 |
| Pedestrian thrown or run over | 5 | 4 | 0 |
| Initial speed >40 MPH* | 0 | 8 | 2 |
| Major auto deformity > 20 inches* | 0 | 8 | 4 |
| Intrusion into passenger compartment > 12 inches* | 1 | 11 | 1 |
| Extrication time > 20 minutes | 3 | 6 | 2 |
| Falls > 20 feet | 7 | 3 | 0 |
| Rollover* | 7 | 6 | 0 |
| Auto-pedestrian injury with > 5 mph impact | 0 | 8 | 0 |
| Motorcycle crash > 20 MPH or with separation of rider and bike | 1 | 10 | 0 |

* unrestrained passenger

# Panel Consensus

- Physiologic Criteria (Step 1): no changes needed
- Anatomic Criteria (Step 2): minor additions only
- Mechanisms Criteria (Step 3): **major changes and data needed**
- Age/Comorbidities (Step 4): **much more information needed**

# Review more data…

# Literature Review: Palanca, 2003

*Emergency Medicine* (2003) 15, 423–428

Emergency Medicine

ORIGINAL RESEARCH

## Mechanisms of motor vehicle accidents that predict major injury

Sylvia Palanca,[1] David McD Taylor,[1] Michael Bailey[2] and Peter A Cameron[1]
[1]Emergency Department, Royal Melbourne Hospital and [2]Department of Epidemiology and Preventive Medicine, Monash University, Melbourne, Victoria, Australia

**Table 2.** Major injury and presence/absence of one or more mechanism of injury

| | All patients | Major injury patients (%) |
|---|---|---|
| No. MOI | 196 | 52 (26.5) |
| 1 MOI | 228 | 83 (36.4) |
| 2 MOI | 129 | 74 (57.4) |
| 3 MOI | 62 | 41 (66.1) |
| 4 MOI | 6 | 3 (50.0) |

*MOI, mechanism of injury.*

621 MVAs analyzed.
Australia

Major Injury: ISS>15, ICU admit, urgent OR, death

# Literature Review: Palanca, 2003

**Table 3.** Uni-variate and multivariate analyses for each mechanism of injury

| Mechanism of injury | All patients† (%) | Major injury patients† (%) | Uni-variate (*P*) | Multi-variate OR (95% CI, *P*) |
|---|---|---|---|---|
| Ejection | 24 (6) | 14 (3) | 0.0736 | 2.5 (1.1–6.0, *P* = 0.04) |
| Fatality‡ | 11 (0) | 7 (0) | 0.1189 | |
| High speed | 320 (146) | 155 (53) | < 0.0001 | 1.5 (1.1–2.2, *P* = 0.003) |
| Intrusion | 156 (38) | 85 (16) | < 0.0001 | 1.5 (1.0–2.3, *P* = 0.047) |
| Extrication | 126 (14) | 82 (7) | < 0.0001 | 2.9 (1.9–4.5, *P* < 0.0001) |
| Rollover‡ | 60 (22) | 23 (3) | 0.6897 | |

†*Number having solitary mechanism of injury in parentheses;* ‡*not included in multivariate regression equation; OR, odds ratio; CI, confidence intervals;* P, P*-value.*

**Table 4.** Summary of existing studies evaluating mechanisms of motor vehicle accidents that predict major injury

| Author | Year | Country | Patient numbers† | Methodology | Outcome measures | Key results |
|---|---|---|---|---|---|---|
| Long *et al.*[10] | 1986 | USA | 287 | retrospective | ISS > 15 death | Fatality in same vehicle and prolonged extrication time … indications for trauma centre evaluation. |
| Henry *et al.*[16] | 1996 | USA | 1545 | prospective | ISS > 15 urgent surgery, death | Fatality in same vehicle, predictive. |
| Esposito *et al.*[20] | 1995 | USA | 1018 | prospective | ISS > 15, death | Fatality in same vehicle, predictive. |
| Kreis *et al.*[14] | 1988 | USA | 4999 | prospective | urgent surgery, ICU admission, death in ED | High speed alone is not a useful predictor. |
| Knopp *et al.*[13] | 1988 | USA | 676 | prospective | ISS > 15 | No mechanism predictive |
| Simmons *et al.*[23] | 1995 | USA | not specified | prospective | ISS > 15, urgent surgery, ICU admission death | No mechanism predictive |

†*Patient numbers are for motor vehicle accidents only.*

Palanca, 2003

# Literature Review: Kohn, 2004

ACAD EMERG MED • January 2004, Vol. 11, No. 1 • www.aemj.org 1

CLINICAL INVESTIGATIONS

## Trauma Team Activation Criteria as Predictors of Patient Disposition from the Emergency Department

Michael A. Kohn, MD, MPP, Jean M. Hammel, MD, Stephen W. Bretz, MD, Ann Stangby, RN, CEM

**Study Setting and Population.** All adult trauma team activations at San Francisco General Hospital (SFGH) between June 8 and October 29, 1998, were included. SFGH is an urban, public, teaching hospital and the only Level 1 trauma center in the city and county of San Francisco.

Two-tier activation system
San Francisco General

# Literature Review: Kohn, 2004

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**TABLE 5. Second-tier Activation Criteria Ranked by Fraction Admitted to the Intensive Care Unit or Operating Room**

| Second-tier Activation Criterion* | Trauma Team Activations | Percent of Second-tier Activations | Admitted to Intensive Care Unit or Operating Room | Percent Admitted to ICU or OR | 95% Confidence Interval |
|---|---|---|---|---|---|
| Crush or degloving injury to extremity | 2 | 0.3 | 1 | 50.0 | 1.3%, 98.7% |
| Motor vehicle crash with ejection | 9 | 1.3 | 3 | 33.3 | 7.5%, 70.1% |
| Multisystem trauma | 24 | 3.6 | 5 | 20.8 | 7.1%, 42.2% |
| Stab wound to torso, head, neck, or thigh | 108 | 16.2 | 16 | 14.8 | 8.7%, 22.9% |
| Gunshot wound to extremity | 20 | 3.0 | 2 | 10.0 | 1.2%, 31.7% |
| Falls ≥ 20 feet | 53 | 7.9 | 5 | 9.4 | 3.1%, 20.7% |
| Motorcycle crash with separation of rider | 109 | 16.3 | 5 | 4.6 | 1.5%, 10.4% |
| Pedestrian hit by motor vehicle | 254 | 38.0 | 10 | 3.9 | 1.9%, 7.1% |
| Motor vehicle crash with rollover | 87 | 13.0 | 3 | 3.4 | 0.7%, 9.7% |
| Motor vehicle crash with death of occupant | 2 | 0.3 | 0 | 0.0 | 0.0%, 84.2% |
| TOTAL | 668 | 100.0 | 50 | 7.5 | 5.8%, 9.9% |

*Thirty-two second-tier activations based on triage nurse's clinical judgment were excluded from the analysis.

Ranked best to worst. Authors recommended eliminating bottom 4 as criteria although they had few cases with death in vehicle. (No intrusion measure)

# Literature Review: Santaniello, 2003

## Mechanism of injury does not predict acuity or level of service need: Field triage criteria revisited

**John M. Santaniello, MD, Thomas J. Esposito, MD, MPH, Fred A. Luchette, MD, Debbie K. Atkian, RN, MSN, Kimberly A. Davis, MD,** *and* **Richard L. Gamelli, MD,** *Maywood, Ill*

Retrospective review of adult (>17) trauma patients admitted between July 1, 1999 and June 30, 2001

830 subjects.

- 300 (36%) met Physiologic criteria
- 115 (14%) met Anatomic criteria
- 414 (50%) met Mechanisms criteria

# Literature Review: Santaniello, 2003

414 (50%) met Mechanisms criteria
- 40 to OR
- 152 to ICU
- 217 to floor

Group I: ISS<15
Group II: ISS 15+

**Table I.** Triage criteria, ISS grouping, mean ISS, and mortality for patients with ED disposition to OR or ICU

| | *ICU* | | *OR* | | *Mean ISS* | | *Mortality** | |
|---|---|---|---|---|---|---|---|---|
| | *I* | *II* | *I* | *II* | *I* | *II* | *I* | *II* |
| P (n = 157) | 113 | 27 | 12 | 5 | 6 | 21 | 1% | 7.3% |
| A (n = 62) | 21 | 10 | 31 | 0 | 6 | 24 | 0% | 36.4%† |
| M (n = 194) | 126 | 27 | 33 | 8 | 4 | 22 | 0.2% | 4.7% |

**Table Ia.** Combined P/A and M criteria results for ISS and mortality in patients with OR or ICU ED dispositions

| | *ICU* | | *OR* | | *Mean ISS* | | *Mortality** | |
|---|---|---|---|---|---|---|---|---|
| | *I* | *II* | *I* | *II* | *I* | *II* | *I* | *II* |
| P/A (n = 219) | 134 | 37 | 43 | 5 | 6 | 23 | 0.5% | 22%† |
| M (n = 194) | 126 | 27 | 33 | 8 | 4 | 22 | 0.2% | 4.7% |

*ISS*, Injury Severity Score; *ED*, emergency department, *OR*, operating room; *ICU*, intensive care unit; *P*, physiologic factors; *A*, anatomic factors; *M*, mechanistic factors.
*$P < .05$.
†1 death in ED.

Only 8% with positive Mechanisms criteria had ISS 15+, but nearly 50% required ICU or OR

# Literature Review: Engum, 2000

**Prehospital Triage in the Injured Pediatric Patient**

By S.A. Engum, M.K. Mitchell, L.R. Scherer, G. Gomez, L. Jacobson, K. Solotkin, and J.L. Grosfeld
*Indianapolis, Indiana*

**Table 2. Simplified Trauma Triage Criteria Distribution (1,285 Patients)**

| | No. (%) |
|---|---|
| Emergency medical technician/paramedic judgement | 518 (40) |
| Pedestrian struck >20 mph | 277 (22) |
| Glasgow Coma Scale score ≤12 | 131 (10) |
| Second or third degree burn involving >15% TBSA | 82 (6) |
| Penetrating injury to head, neck, chest, abdomen, or groin | 69 (5) |
| Blood pressure ≤80 mm Hg (systolic) | 65 (5) |
| Rollover of vehicle | 58 (5) |
| Fall from >20 feet | 43 (3) |
| Ejection from vehicle | 17 (1) |
| Respiratory rate <10/min or >29/min | 11 (1) |
| Extrication of patient from vehicle | 10 (1) |
| Paralysis | 4 (1) |

1285 pediatric patients (<15)
Studied prospectively

Note absence of speed, crush and intrusion criteria

# Literature Review: Engum, 2000

Table 3. Simplified Trauma Alert Criteria Positive Predictive Value (Accuracy)

| Criteria | No. | ER | ORMA | ICU | ORMI | WARD | DC | ACC% |
|---|---|---|---|---|---|---|---|---|
| BP ≤90 | 65 (133) | 28 (30) | 7 (47) | 21 (27) | 1 (13) | 7 (6) | 1 (10) | 86 (78) |
| GCS ≤12 | 131 (152) | 1 (5) | 13 (19) | 88 (55) | 2 (12) | 18 (18) | 9 (43) | 78 (52)* |
| RR <10 >29 | 11 (4) | 1 (0) | 0 (2) | 7 (0) | 1 (90) | 2 (1) | 0 (1) | 73 (50) |
| Penetrating | 69 (332) | 0 (5) | 7 (65) | 13 (34) | 3 (12) | 12 (100) | 34 (116) | 29 (31) |
| Burn >15% | 82 (82) | 1 (2) | 6 (6) | 58 (67) | 0 (0) | 14 (1) | 3 (6) | 79 (91)† |
| Paralysis | 4 (14) | 0 (0) | 0 (0) | 2 (7) | 0 (0) | 1 (3) | 1 (4) | 50 (50) |
| Ejection | 17 (23) | 0 (0) | 0 (0) | 4 (5) | 1 (4) | 6 (5) | 6 (9) | 24 (22) |
| Rollover | 58 (55) | 0 (0) | 1 (4) | 1 (6) | 2 (2) | 5 (6) | 49 (37) | 3 (18)‡ |
| Extrication | 10 (34) | 0 (0) | 0 (4) | 0 (9) | 1 (4) | 6 (7) | 3 (10) | 0 (38)§ |
| Fall >20ft. | 43 (34) | 0 (0) | 0 (0) | 14 (9) | 0 (3) | 12 (7) | 17 (15) | 33 (26) |
| Ped >20mph | 277 (99) | 1 (1) | 2 (2) | 41 (7) | 23 (26) | 66 (9) | 144 (52) | 16 (10) |
| Paramedic judgment | 518 (364) | 0 (0) | 4 (14) | 58 (60) | 28 (46) | 182 (49) | 246 (195) | 12 (20)‖ |
| Total | 1285 (1326) | 32 (43) | 40 (143) | 307 (286) | 62 (124) | 331 (212) | 513 (498) | 29 (37) |

NOTE. Values are expressed as pediatric patients with adult patients in parentheses.

Abbreviations: ER, died in emergency room; ORMA, major operating room procedure; ICU, admit to intensive care unit; ORMI, minor OR procedure; WARD, admit to ward bed; DC, discharged from emergency room; ACC%, percent accuracy of criterion = (ER + ORMA + ICU)/N.

Accuracy for predicting ED death, ICU admit or OR.

**Pediatric (<15) vs. Adult**

| | | | |
|---|---|---|---|
| Fall >20 ft | 33% (26%) | Ejection | 24% (22%) |
| Ped struck >20mph | 16% (10%) | Rollover | 3% (18%) |
| Extrication | 0% (38%) | | |

1285 peds patients vs. 1326 adult patients

# Mechanism Criteria Summary

| Ejection | | Death | | Pedestrian | |
|---|---|---|---|---|---|
| **KEEP** | **DISCARD** | **KEEP** | **DISCARD** | **KEEP** | **DISCARD** |
| Esposito 95 | | Esposito 95 | | Esposito 95 | Kohn 04 |
| Henry 96 | | Henry 96 | | | |
| Knopp 88 | | Knopp 88 | | | |
| Palanca 03 | | Long 86 | | | |
| Kohn 04 | | | | | |
| Engum 00 | | | | Engum 00 Peds* | |

Keep if PPV >20%, Discard if PPV <10%

# Mechanism Criteria Summary

| Intru >12 | | Extric >20 | | Falls >20 | |
|---|---|---|---|---|---|
| **KEEP** | **DISCARD** | **KEEP** | **DISCARD** | **KEEP** | **DISCARD** |
| Esposito 95 | | Knopp 88 | | Engum 00 | Esposito 95 |
| Henry 96* | | Palanca 03 | | **Yagmur 04** | Kohn 04 |
| Palanca 03 | | Long 86 | | | |
| | | Engum 00 | | | |

Keep if PPV >20%, Discard if PPV <10%

# Mechanism Criteria Summary

**Speed >40**

| **KEEP** | **DISCARD** |
|---|---|
| Palanca 03* | Henry 96 |

**Deform >20**

| **KEEP** | **DISCARD** |
|---|---|
| Esposito 95 | Henry 96 |

**Rollover**

| **KEEP** | **DISCARD** |
|---|---|
| | Esposito 95 |
| | Palanca 03 |
| | Kohn 04 |

**MCA**

| **KEEP** | **DISCARD** |
|---|---|
| | Kohn 04 |

Keep if PPV >20%, Discard if PPV <10%

# Literature Review: Eigen, 2005

DOT HS 809 894 July 2005

**Technical Report**

## Rollover Crash Mechanisms and Injury Outcomes for Restrained Occupants

**Table 3: Annualized Number of Occupants Sustaining Rollover Crashes, by Quarter Turns and Vehicle Body Type**

| Number of Quarter Turn | Passenger Car | Sports Utility Vehicle | Van | Pick up Truck | Total |
|---|---|---|---|---|---|
| 1 | 8,318 | 5,340 | 2,336 | 6,900 | 22,894 |
| 2 | 33,515 | 28,397 | 1,251 | 10,356 | 73,519 |
| 3 | 3,445 | 2,877 | 1,322 | 1,379 | 9,023 |
| 4 | 14,487 | 12,824 | 711 | 4,459 | 32,481 |
| 5 | 362 | 526 | 64 | 1,090 | 2,042 |
| 6 | 9,043 | 2,600 | 400 | 1,774 | 13,817 |
| 7 | 20 | 918 | 8 | 236 | 1,182 |
| 8 | 6,012 | 1,515 | 67 | 314 | 7,908 |
| 9 | 76 | 56 | 26 | 297 | 455 |
| 10 | 1,181 | 70 | 99 | 88 | 1,438 |
| 11 | 0 | 0 | 0 | 10 | 10 |
| 12 | 311 | 103 | 30 | 0 | 444 |
| 13 | 0 | 0 | 0 | 0 | 0 |
| 14 | 20 | 13 | 9 | 113 | 155 |
| 15 | 0 | 0 | 0 | 0 | 0 |
| 16 | 0 | 2 | 0 | 40 | 42 |
| >16 | 0 | 107 | 18 | 5 | 130 |
| End-over-End | 550 | 57 | 74 | 44 | 725 |
| Total | 77,340 | 55,405 | 6,415 | 27,105 | 166,263 |

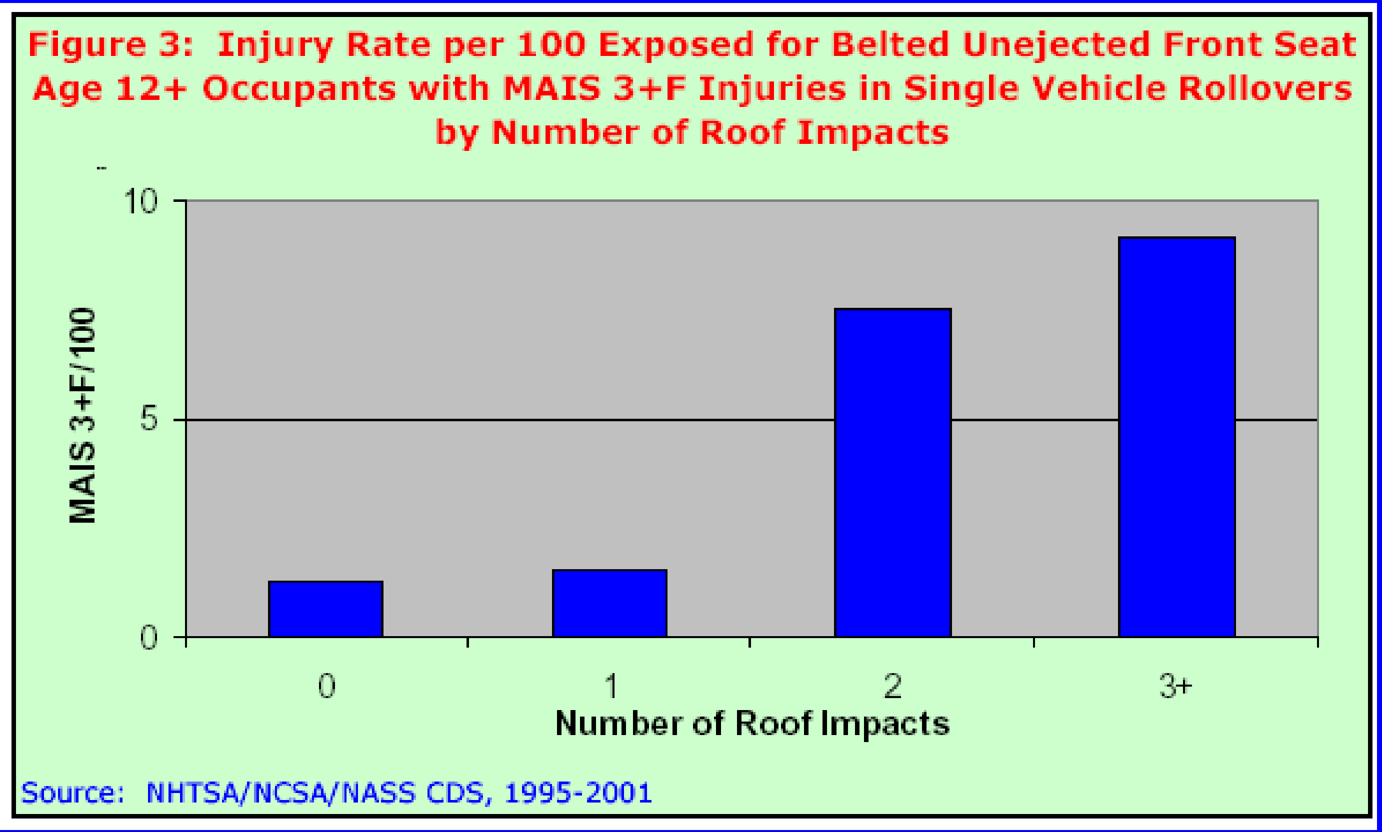
Source: NASS CDS, 1995 – 2001

Note: Annualized seven-year frequency.

**166,263** rollover occupants per year

# Literature Review: Eigen, 2005

**166,263** rollover occupants per year




Risk is very low for belted, unejected rollover occupants.
(few have more than 1 roof impact)

# NASS rollover

**Table 5**
**Percentage of Injured Occupants, by Injury Severity and Crash Attitude**

| Injury Severity (MAIS) | Crash Attitude | |
|---|---|---|
| | Planar | Rollover |
| Minor | 86 % | 74 % |
| Moderate | 9 % | 15 % |
| Serious - Maximum | 5 % | 10 % |
| All Known Injured | 100 % | 100 % |

Note: Slight differences may exist in percentage calculation owing to rounding.
Source: NCSA, NHTSA, NASS-CDS, 1995-2001

Eigen, 2003, DOT HS 809 692

# NASS rollover

Table 1: Risk of Injury for Two Intrusion Measures

| | Maximum Vertical Intrusion | | Maximum Roof Intrusion | |
|---|---|---|---|---|
| **Intrusion Amount** | **Risk of ISS 9+ Injury** | **Risk of ISS 15+ Injury** | **Risk of ISS 9+ Injury** | **Risk of ISS 15+ Injury** |
| >=1" | 7.2% | 3.1% | 7.5% | 3.4% |
| >3" | 7.7% | 3.6% | 7.8% | 3.8% |
| >6" | 8.4% | 4.2% | 10.1% | 5.2% |
| >12" | 12.6% | 6.6% | 14.5% | 8.3% |
| >18" | 18.2% | 11.4% | 23.0% | 14.8% |
| >24" | 24.1% | 19.3% | 20.8% | 16.1% |

# NASS rollover

Table 3: Risk of Injury for Landing and Ejection Criteria

| Criterion | Risk of ISS 9+ Injury | Risk of ISS 15+ Injury |
|---|---|---|
| Land On Roof | 5.9% | 2.1% |
| Land On Side | 6.2% | 3.3% |
| Land Upright | 5.9% | 3.2% |
| Any Ejection | 38.1% | 21.5% |
| Complete Ejection Only | 44.9% | 27.4% |

# NASS rollover

Table 5: Risk of Injury for Number of Quarter Turns

| Criterion | Risk of ISS 9+ Injury | Risk of ISS 15+ Injury |
|---|---|---|
| >=2 | 6.2% | 2.8% |
| >=3 | 8.2% | 3.7% |
| >=4 | 8.3% | 3.6% |
| >=5 | 12.0% | 4.8% |
| >=6 | 12.9% | 5.1% |
| >=7 | 10.3% | 6.1% |
| >=8 | 10.3% | 6.1% |
| >=9 | 20.8% | 13.9% |

# NASS rollover

Table 7: Bottom Line for Various Criteria

| | For every occupant correctly brought to a trauma center, there will be: | | | |
|---|---|---|---|---|
| Criterion | ISS 9+ False Alarms | ISS 9+ Misses | ISS 15+ False Alarms | ISS 15+ Misses |
| **Any Ejection** | 1.62 | 1.48 | 3.65 | 1.01 |
| **Roof Intrusion >=12”** | 6.94 | 2.27 | 14.04 | 1.84 |

# Mechanism Criteria Summary

**Speed >40**

| KEEP | DISCARD |
|---|---|
| Palanca 03* | Henry 96 |

**Deform >20**

| KEEP | DISCARD |
|---|---|
| Esposito 95 | Henry 96 |

**Rollover**

| KEEP | DISCARD |
|---|---|
| | Esposito 95 |
| | Palanca 03 |
| | Kohn 04 |

**MCA**

| KEEP | DISCARD |
|---|---|
| | Kohn 04 |

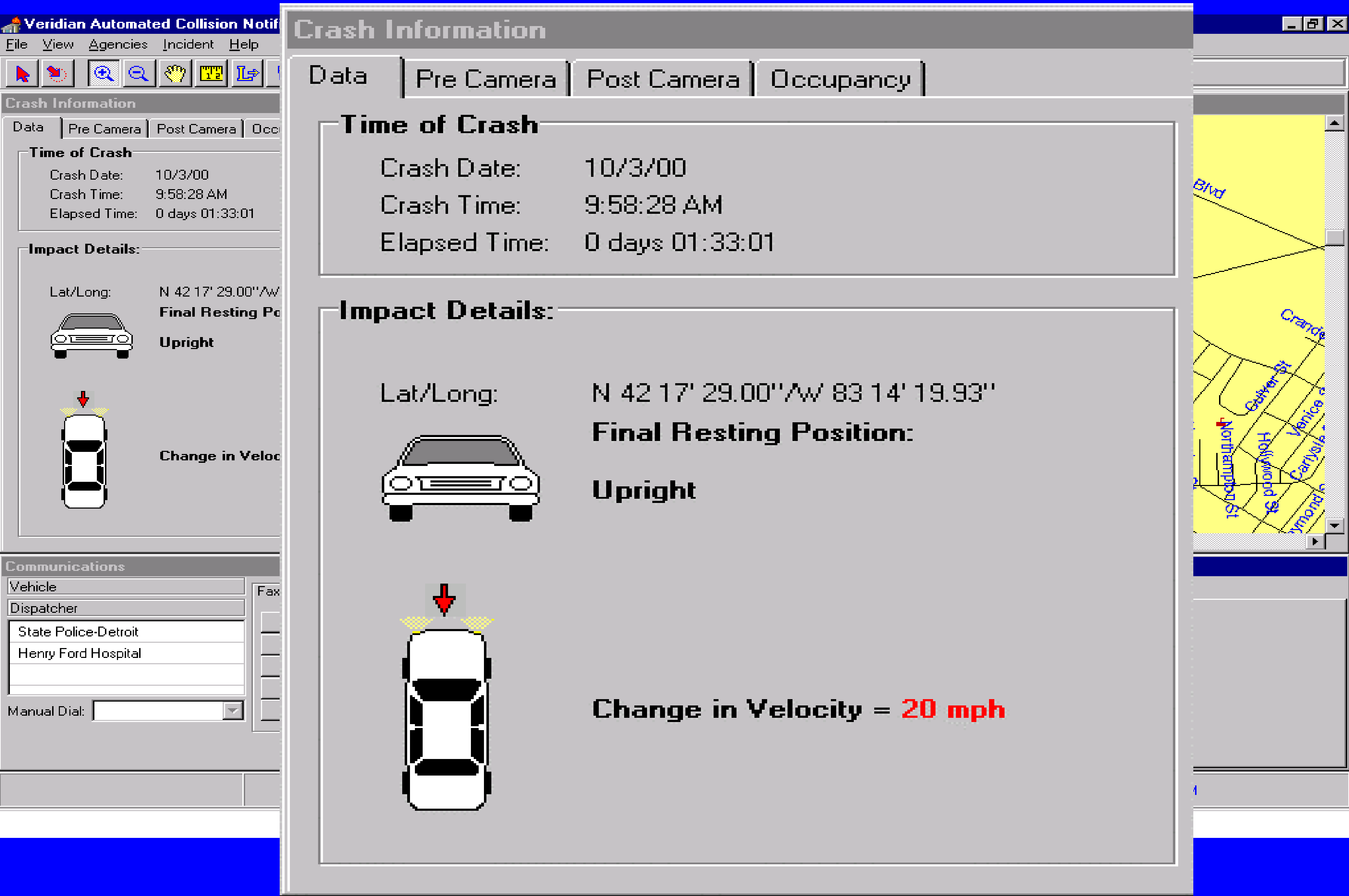
Keep if PPV >20%, Discard if PPV <10%

# Mechanism Criterion

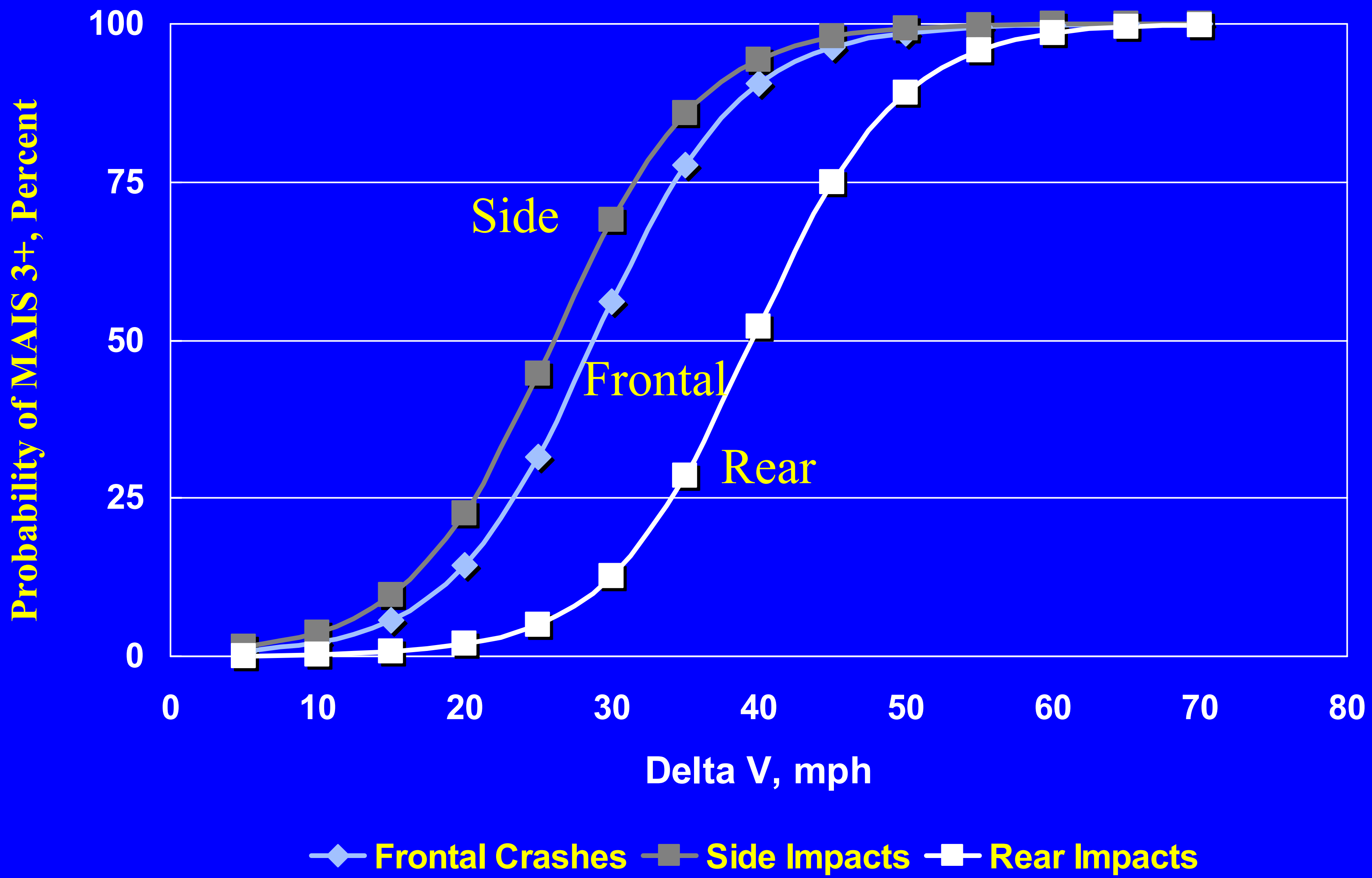
Initial Speed > 40 MPH

- **Car 45 mph**
  - **Head on into tree**
  - **Head on into semi-trailer going 40 mph**
  - **Into back of car going 10 mph**
  - **Strikes side of another car**
- ***How do you know what speed??***

# Response Center – Screen I



## Sensitivity of Serious Injury (Max AIS 3+) to the Direction of Force, as a Function of Car Crash Severity




The NASS/CDS 1988-1995

# Mechanism Criteria

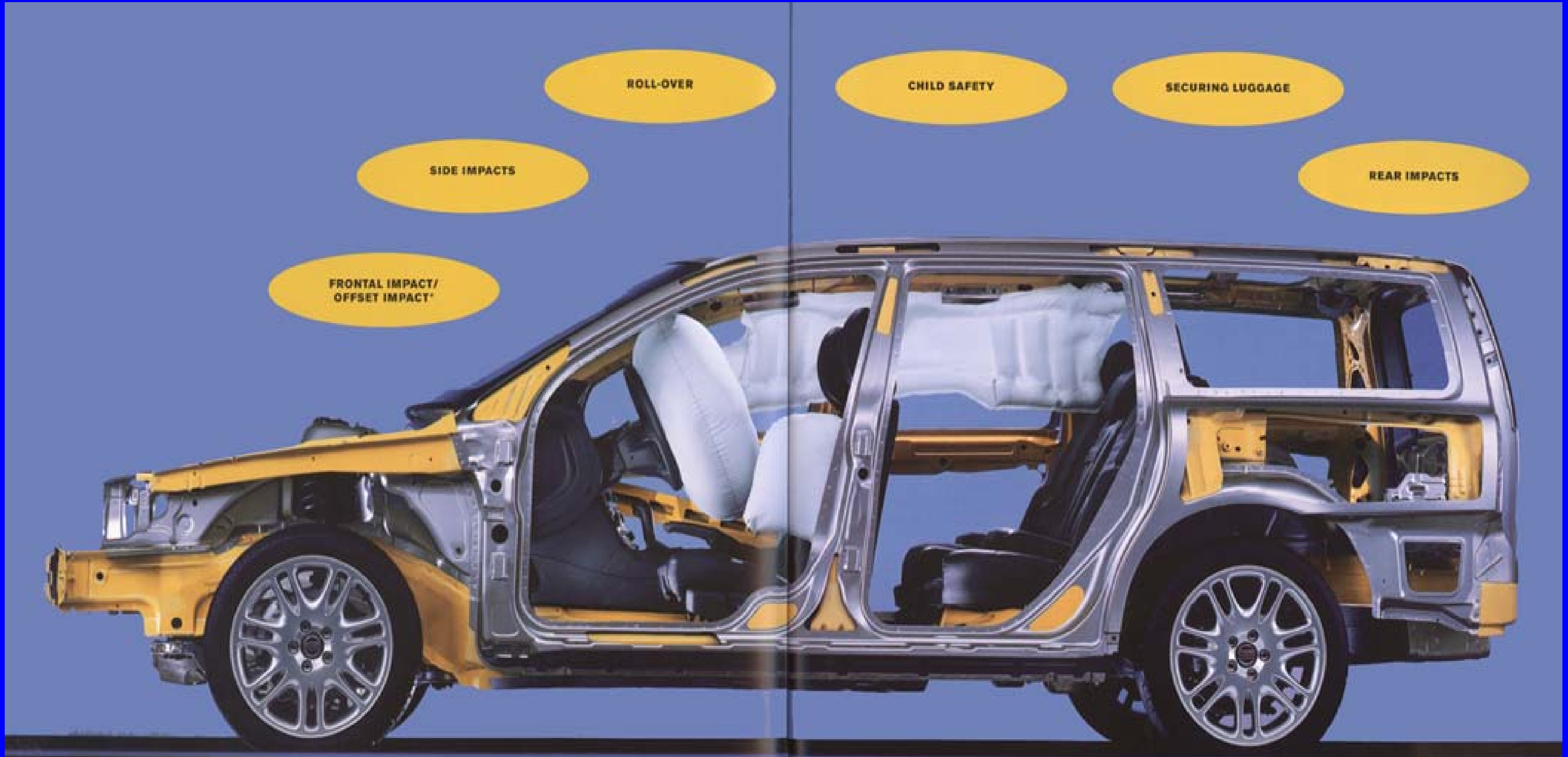
*Crash Severity*

**DISCARD** Initial Speed >40 criterion

**ADD** ACN telemetry criterion

# Mechanism Criterion

Major auto deformity > 20 inches



# Mechanism Criteria Summary

### Speed >40

| KEEP | DISCARD |
|---|---|
| Palanca 03* | Henry 96 |

### Deform >20

| KEEP | DISCARD |
|---|---|
| Esposito 95 | Henry 96 |

### Rollover

| KEEP | DISCARD |
|---|---|
| | Esposito 95 |
| | Palanca 03 |
| | Kohn 04 |

### MCA

| KEEP | DISCARD |
|---|---|
| | Kohn 04 |

Keep if PPV >20%, Discard if PPV <10%

# Mechanism Criterion

Intrusion > 12 inches into passenger compartment

# NASS Frontal Impact

Table 2: Risk of Given Level of ISS as a Function of Intrusion

| Intrusion Amount | Maximum Intrusion @ Seat ISS 9+ | Maximum Intrusion @ Seat ISS 15+ | Longitudinal Intrusion @ seat ISS 9+ | Longitudinal Intrusion @ seat ISS 15+ | Maximum Longitudinal Intrusion anywhere ISS 9+ | Maximum Longitudinal Intrusion anywhere ISS 15+ |
|---|---|---|---|---|---|---|
| No Intr. | 1.56% | 0.50% | 1.66% | 0.55% | 1.31% | 0.38% |
| 1”+ | 3.80% | 1.26% | 4.45% | 1.47% | 3.00% | 0.94% |
| 3”+ | 8.96% | 3.10% | 11.40% | 3.89% | 6.75% | 2.30% |
| 6”+ | 19.66% | 7.43% | 26.21% | 9.90% | 14.47% | 5.51% |
| 12”+ | 37.85% | 16.77% | 49.51% | 22.96% | 28.35% | 12.62% |
| 18”+ | 60.24% | 33.61% | 73.03% | 44.70% | 48.06% | 26.35% |
| 24”+ | 79.03% | 55.98% | 88.20% | 68.68% | 68.39% | 46.98% |

# NASS Side Impact

**Table 1a**
**Risk of Injury for Maximum Lateral Intrusion**

| | Occ on Struck Side | | Occ on Unstruck Side | |
|---|---|---|---|---|
| **Intrusion Amount** | **Risk of ISS 9+ Injury** | **Risk of ISS 15+ Injury** | **Risk of ISS 9+ Injury** | **Risk of ISS 15+ Injury** |
| >=1" | 9.6% | 5.0% | 5.2% | 2.2% |
| >=3” | 12.9% | 6.7% | 6.8% | 2.9% |
| >=6” | 21.0% | 11.3% | 8.2% | 4.5% |
| >=12” | 38.8% | 23.3% | 15.3% | 8.0% |
| >=18” | 45.2% | 29.6% | 19.8% | 9.9% |
| >=24” | 57.7% | 34.1% | 33.3% | 22.0% |

# NASS Side Impact

**Table 1b**
**Risk of Injury for Maximum Lateral Intrusion at Occupant Seat Position**

| | Occ on Struck Side | | Occ on Unstruck Side | |
|---|---|---|---|---|
| **Intrusion Amount** | **Risk of ISS 9+ Injury** | **Risk of ISS 15+ Injury** | **Risk of ISS 9+ Injury** | **Risk of ISS 15+ Injury** |
| >=1" | 11.4% | 6.1% | 12.6% | 8.6% |
| >=3” | 15.8% | 8.6% | 16.8% | 11.1% |
| >=6” | 25.3% | 14.3% | 22.6% | 13.9% |
| >=12” | 45.5% | 27.3% | 54.0% | 41.3% |
| >=18” | 47.1% | 30.9% | 51.8% | 34.5% |
| >=24” | 59.7% | 39.4% | 94.8% | 78.4% |

Slight increase in sensitivity if intrusion measured at occupant position

# NASS Side Impact

**Table 1c**
**Risk of Injury for Maximum Intrusion (Any Direction) at Occupant Seat Position**

| | Occ on Struck Side | | Occ on Unstruck Side | |
|---|---|---|---|---|
| **Intrusion Amount** | **Risk of ISS 9+ Injury** | **Risk of ISS 15+ Injury** | **Risk of ISS 9+ Injury** | **Risk of ISS 15+ Injury** |
| >=1" | 11.4% | 6.1% | 11.5% | 6.3% |
| >=3” | 15.7% | 8.4% | 14.9% | 7.6% |
| >=6” | 25.4% | 14.3% | 14.8% | 8.1% |
| >=12” | 46.3% | 28.5% | 19.4% | 15.0% |
| >=18” | 54.4% | 35.5% | 14.2% | 11.0% |
| >=24” | 59.5% | 43.2% | 22.7% | 20.5% |

Any intrusion as good as maximum lateral intrusion

# Mechanism Criteria

*Vehicle Damage*

**DISCARD**

Deformation > 20 inches
Intrusion >12 inches
Prolonged extrication (redundant)

**ADD**

Intrusion > 12 inches at occupant location
Intrusion >18 inches anywhere

# CIREN

1162 subjects with ISS 15+
Nearly all planar MVC occupants evaluated at Trauma Center

(23%) 268 Picked up on Physiologic Criteria

(41%) 210 Picked up on Anatomic criteria

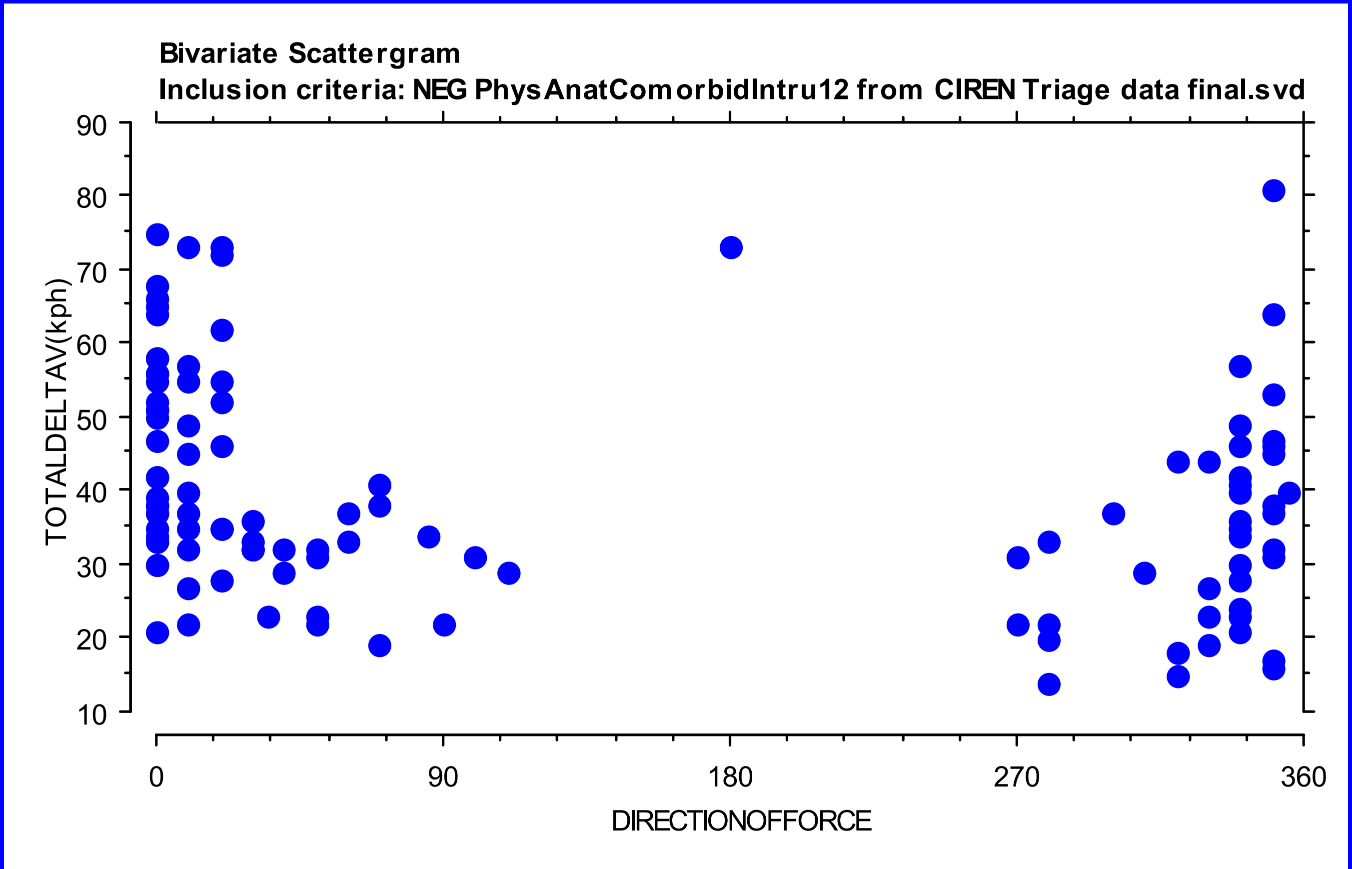
(63%) 255 Picked up on Mechanisms criteria
(Intrusion >12in)

(80%) 192 Picked up on Comorbidity criteria

*(20%) 237 escaped triage criteria*

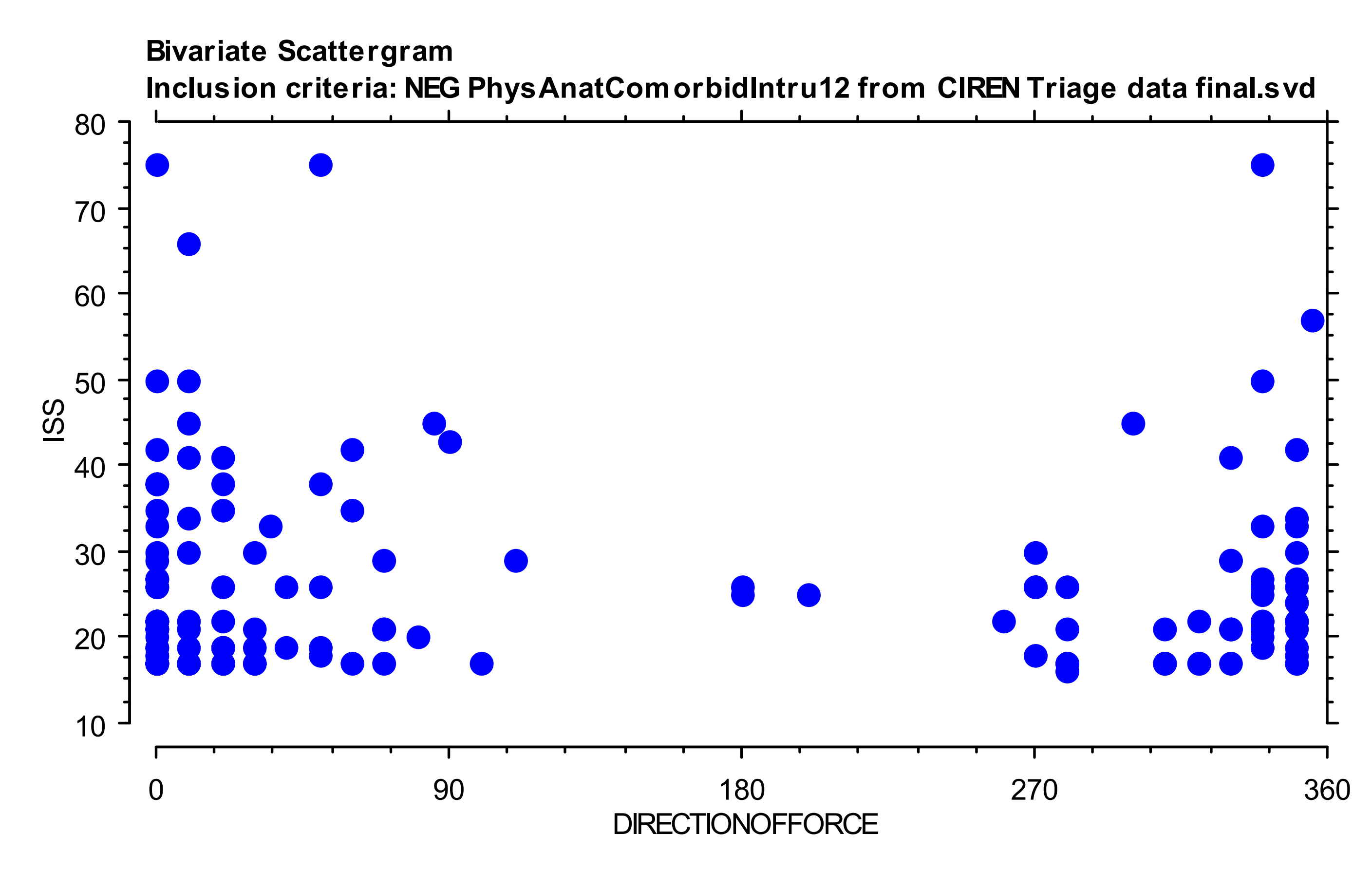
# CIREN

Characteristics of CIREN subjects without ANY positive field triage criteria.
Crash Severity vs. Principal Direction of Force.



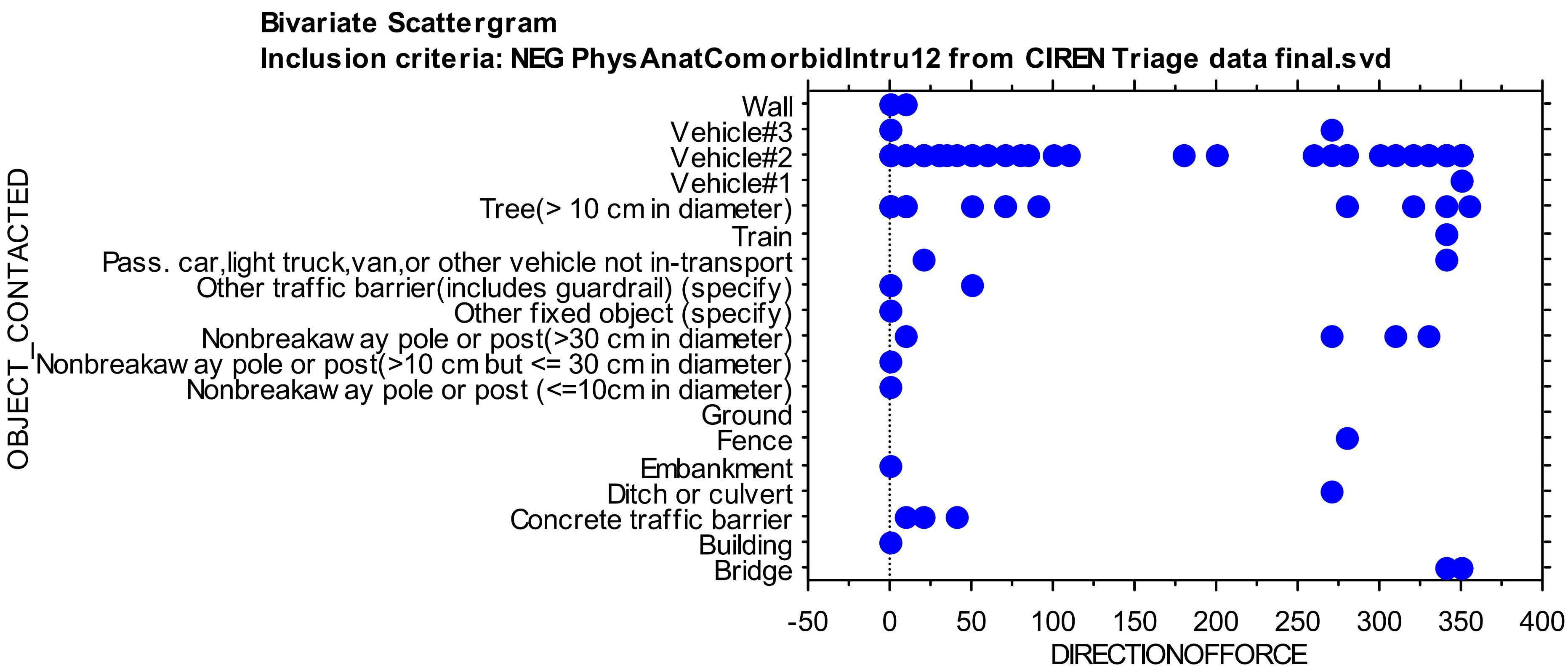
# CIREN

Characteristics of CIREN subjects without ANY positive field triage criteria.
ISS vs. Principal Direction of Force.



# CIREN

Characteristics of CIREN subjects without ANY positive field triage criteria.
Object Struck vs. Principal Direction of Force.



# CIREN

Characteristics of CIREN subjects without ANY positive field triage criteria.
Object struck

**Frequency Distribution for OBJECT_CONTACTED**
**Inclusion criteria: NEG PhysAnatComorbidIntru12 from CIREN Triage data final.svd**

| | Count |
|---|---|
| Bridge | 2 |
| Building | 2 |
| Concrete traffic barrier | 3 |
| Ditch or culvert | 1 |
| Embankment | 1 |
| Fence | 1 |
| Ground | 1 |
| Nonbreakaway pole or post (<=10cm in ... | 1 |
| Nonbreakaway pole or post(>10 cm but ... | 1 |
| Nonbreakaway pole or post(>30 cm in di... | 4 |
| Other fixed object (specify) | 2 |
| Other traffic barrier(includes guardrail) (... | 3 |
| Pass. car,light truck,van,or other vehicle ... | 2 |
| Train | 1 |
| Tree(> 10 cm in diameter) | 29 |
| Vehicle#1 | 2 |
| Vehicle#2 | 98 |
| Vehicle#3 | 4 |
| Wall | 3 |
| Total | 161 |

# Data Analysis

*Analysis Procedure*

*A. CIREN Analysis*

1. *For each case, identify whether the occupant qualified for transport under physiological or anatomical criteria or not*
2. *Among CIREN cases, 27% did not pass (qualify for transport) physiological or anatomical criteria; all AIS 3+ injuries to these occupants were classified as Type 1 (i.e., possibly failing to present with notable symptoms)*
3. *Injuries sustained **only** by the 73% of occupants who did pass physiological or anatomical criteria were classified as Type 2 (i.e., always presenting with notable symptoms)*

*B. NASS Analysis*

1. *Identify "target" occupants:*
   a. *Any occupant with type 1 injury from CIREN*
   b. *Any occupant with AIS 3+ injury not found in CIREN list*
2. *Remove from analysis:*
   *Any occupant with type 2 injury*
3. *All other occupants are "no-transport" occupants*
4. *Evaluate various crash criteria in terms of how well the criterion distinguishes between target & no-transport occupants in NASS*

# Results

*27% of CIREN cases did not meet transport criteria under Step 1 or Step 2*

*There are approximately 41,000 Type 1 injuries in frontal crashes each year;*
*12,600 in near-side impacts;*
*7,200 in far-side impacts; and*
*15,600 in rollovers*

# CIREN Analysis

## *Top 10 Type 1 Injuries (May Not Meet Step 1 & 2 Criteria)*

| FRONTAL | |
|---|---|
| 1. Femur fracture shaft | 6. Tibia fracture shaft open/displaced/comminuted |
| 2. Cerebrum subarachnoid hemorrhage | 7. Ulna fracture open/displaced/comminuted |
| 3. Radius fracture open/displaced/comminuted | 8. Humerus fracture open/displaced/comminuted |
| 4. Lung contusion unilateral with or without hemo-/pneumothorax | 9. Rib cage fracture >3 ribs on one side and <=3 ribs on other side, stable chest or NFS == with hemo- |
| 5. Lung contusion bilateral with or without hemo-/pneumothorax | 10. Rib cage fracture 2-3 ribs any location with hemo-/pneumothorax |

# CIREN Analysis

## Top 10 Type 1 Injuries (May Not Meet Step 1 & 2 Criteria)

| SIDE | |
|---|---|
| 1. Cerebrum subarachnoid hemorrhage | 6. Rib cage fracture 2-3 ribs any location with hemo-/pneumothorax |
| 2. Lung contusion unilateral with or without hemo-/pneumothorax | 7. Rib cage fracture >3 ribs on one side and <=3 ribs on the other side, stable chest or NFS |
| 3. Lung contusion bilateral with or without hemo-/pneumothorax | 8. Rib cage fracture >3 ribs on one side and <=3 ribs on other side, stable chest or NFS == with hemo- |
| 4. Cerebrum intraventricular hemorrhage/intracerebral hematoma in ventricular system | 9. Cerebrum hematoma/hemorrhage subdural small |
| 5. Femur fracture shaft | 10. Radius fracture open/displaced/comminuted |

# CIREN Analysis

## *Top 10 Type 1 Injuries (May Not Meet Step 1 & 2 Criteria)*

| ROLLOVER | |
|---|---|
| 1. Cerebrum subarachnoid hemorrhage | 6. Radius fracture open/displaced/comminuted |
| 2. Lung contusion bilateral with or without hemo-/pneumothorax | 7. Cerebrum intraventricular hemorrhage/intracerebral hematoma in ventricular system |
| 3. Lung contusion unilateral with or without hemo-/pneumothorax | 8. Rib cage fracture >3 ribs on one side and <=3 ribs on the other side, stable chest or NFS |
| 4. Femur fracture shaft | 9. Rib cage fracture 2-3 ribs any location with hemo-/pneumothorax |
| 5. Cerebrum hematoma/hemorrhage subdural small | 10. Humerus fracture open/displaced/comminuted |

# Additional Criteria Considered

- Restraint Use
- Crashes involving incompatible vehicles
- Improperly restrained children
- Different deformation levels
- Specific types of deformation (e.g. SW)
- Special crashes
  - Poles/narrow objects
  - Specific PDOF

# Panel Goal

Keep one page and "Elegantly simple"


Measure vital signs and level of consciousness

**Step One**

| | |
|---|---|
| Glasgow Coma Scale | <14 or |
| Systolic blood pressure | <90 or |
| Respiratory rate | <10 or >29 (<20 in infant less than one year) |

Yes

Take to a trauma center. Steps 1 and 2 triage attempts to identify the most seriously injured patients in the field. These patients would preferentially be transported to the highest level of care within the trauma system.

No

Assess anatomy of injury

**Step Two**

- All penetrating injuries to head, neck, torso, and extremities proximal to elbow and knee
- Flail chest
- Two or more proximal long-bone fractures
- Crush, degloved or mangled extremity
- Amputation proximal to wrist and ankle
- Pelvic fractures
- Open or depressed skull fracture
- Paralysis

Yes

Take to a trauma center. Steps 1 and 2 triage attempts to identify the most seriously injured patients in the field. These patients would preferentially be transported to the highest level of care within the trauma system.

No

Assess mechanism of injury and evidence of high-energy impact

## Step 1 & 2 criteria unchanged, directed action consistent with inclusive trauma system

Step Three

- Falls
  - Adults: > 20 feet (one story is equal to 10 feet)
  - Children: > 10 feet or two to three times the height of the child
- High-risk auto crash
  - Intrusion : > 12 inches occupant site; > 18 inches any site
  - Ejection (partial or complete) from automobile
  - Death in same passenger compartment
  - Vehicle telemetry data consistent with high risk of injury
- Auto v pedestrian/ bicyclist thrown, run over, or with significant (>20 mph) impact
- Motorcycle crash > 20 mph

Yes

Transport to closest appropriate trauma center which, depending on the trauma system, need not be the highest level trauma center

No

Assess special patient or system considerations

**Reorganization of mechanism criteria:**

Initial speed, deformation and rollover criteria deleted.

ACN telemetry added.

Stronger instruction with consideration of inclusive trauma systems.

## Step Four

- Age
  - Older Adults: Risk of injury death increases after age 55
  - Children: Should preferentially be triaged to pediatric-capable trauma centers
- Anti-coagulation and bleeding disorders
- Burns
  - Without other trauma mechanism: Triage to burn facility
  - With trauma mechanism: Triage to trauma center
- Time sensitive extremity injury
- End stage renal disease requiring dialysis
- Pregnancy > 20 weeks
- EMS provider judgment

**Yes** → Contact medical control and consider transport to trauma center or a specific resource hospital.

**No** → Transport according to protocol

When in doubt, transport to a trauma center

# Changes with New Guidelines

- Mechanism criteria updated
- Altered approach to co-morbidities
- De-emphasize medical control
- Increased emphasis on EMS judgment

- Toolkit
  - Local calibration of field triage to optimally fit available resources
  - Educational materials for training

# Progress

- Reviewed and accepted by
  - CDC, NHTSA, HRSA
  - American College of Surgeons
  - American College of Emergency Physicians
  - National Association of EMS Physicians

  - Guidelines and supporting documents are in press

  - Toolkit being developed

# Implications

- Revision of field triage protocols around the world
- Greater coordination of EMS/Medical Centers
- Better utilization of resources and support of inclusive trauma systems (preparation for mass casualty incident & homeland security)
- Health care costs & medical compensation

# New considerations

Need to assess intrusion

Need to assess for partial ejection

Detection of triage misses

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